

## SPECIFICATION SHEET

### Supply, installation and commissioning of a *Wafer Bonding Line* for ICFO, financed by FEDER Catalunya 2021-2027

**FILE NUMBER: ICFO-2026-050**

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## CLAUSE 1. Object of the contract

The object of this contract is the supply, installation and commissioning of a “**Wafer Bonding Line**” for ICFO, financed by FEDER Catalunya 2021-2027.

The items to be supplied are classified under the following CPV (Common Public Procurement Vocabulary): - **38000000-5** Laboratory, optical and precision equipment (except glasses).

## CLAUSE 2. Needs to satisfy

PhotonChip is a platform project that will help bring photonic technologies, in particular integrated photonics and photonic chips, from scientific feasibility to prototype stage to be applied in, for instance, communications as 6G transceivers, sensors, quantum computing and technology platforms.

Once operational, PhotonChip will cover the whole photonic chip value chain (design, packaging, testing) and train new experts thanks to dedicated programs.

As part of the Institute of Photonic Sciences (ICFO), PhotonChip will use advanced technologies as quantum technologies for cybersecurity, virtual and augmented reality, artificial intelligence, and machine learning.

In the development of the project, ICFO needs to acquire **Wafer Bonding Line**, to provide the ICFO Packaging Line the possibility to realize aligned wafer bonding. Wafer bonding is a key technology for advanced semiconductor packaging at wafer level, including 3D integration, capping, the manufacture of engineered substrates and wafer thinning.

As such, the Wafer Bonding Line must comprise the following equipment units, all of them capable to handle up to 200mm wafers:

- A. A wafer bonding system including two (2) processing chambers to enable different bonding processes and avoid cross-contamination.
- B. A high-precision wafer bond aligner system with wafer clamping, pre-bond alignment.
- C. A low temperature plasma activation equipment for surface preparation in plasma-activated bonding processes.
- D. A wafer cleaner station with enhanced functionalities, providing effective surface cleanliness prior to bonding, a bond module for bare wafers and a post-bond IR inspection module.

### CLAUSE 3. Technical requirements

#### Technical proposal structure - minimum mandatory equipment characteristics

The Wafer Bonding Line shall incorporate all the functionalities and components needed to perform, at minimum, the following bonding technologies:

- a) Plasma activated bonding
- b) Fusion bonding
- c) Thermocompression bonding
- d) Bonding with thermally cured polymers interlayers

The Wafer Bonding Line shall comprise the units detailed below. All units shall operate in semi-automatic mode: manual wafer loading and handling, and automatic execution and control of the processes.

The minimum mandatory technical specifications of each unit are detailed in the following sections.

A. Wafer bonder system. It shall include a dual chamber wafer bonder, where Chamber 1 is dedicated to direct bonding processes, and Chamber 2 to adhesive bonding or temporary bonding. Each chamber shall be equipped with:

- 1. Top and bottom heaters, capable of reaching the following maximum temperatures of at least:
  - a. 500°C in chamber 1
  - b. 200°C in chamber 2.
- 2. Adjustable heat up ramp rate up to 45 °C / min
- 3. Capability of rapid cooling allowing programmable cooling rate of 30 °C/ min from 400 to 200 °C.
- 4. Separation spacers (or flags) with controlled pulling, allowing either simultaneous or sequential removal.
- 5. Bonding force control system, with bonding force as follows:
  - a. Chamber 1 shall support bonding forces up to at least 20 kN.
  - b. Chamber 2 shall support bonding forces up to at least 10 kN.
- 6. Capability of achieving a vacuum level better than  $<1 \times 10^{-5}$  mbar.
- 7. Automated chamber opening/closing
- 8. Modular design allowing integration of additional process modules (e.g. anodic bonding, formic acid bubbler, higher bonding forces) as optional or future upgrades.
- 9. Two complete bonding kits (one per chamber) for 100 mm and 200 mm wafers, including bond chuck and pressure disks

B. Wafer bond aligner system. The aligner shall provide high precision alignment suitable for bonding processes of patterned wafers, with the following minimum requirements:

- 1. The aligner shall be mounted on an isolated granite base to ensure mechanical and vibration stability.
- 2. Alignment accuracy of  $\pm 2 \mu\text{m}$  or below
- 3. Alignment in four (4) axis, X, Y, Z and rotation.
  - a. At least the vertical axis (Z) shall be motorized.
  - b. Alignment stage resolution 0.1  $\mu\text{m}$
- 4. Automatic compensation of wafer wedge and parallelism errors.
- 5. Controlled and adjustable wafer contact force, with a minimum operating range of 5 to 40 N.
- 6. Compatible with a total wafer stack thickness of at least 4.0 mm.

7. Optical system. It shall include:
    - a. Microscope with high resolution CCD cameras, digital zoom and at least 5x magnification objective.
    - b. Capability to adjust and program light source spectral to improve markers visibility and therefore alignment reliability.
  8. Modular design allowing integration of additional process modules (e.g. lithography module, fully automated handling) as optional or future upgrades.
  9. Wafer chucks for 100 mm and 200 mm wafer diameters.
- C. Plasma activation equipment. The system shall include a low temperature plasma activation system suitable for plasma activated bonding processes. Minimum requirements:
1. It shall include a vacuum processing chamber enabling wafer processing in controlled atmosphere conditions.
    - a. High-vacuum operation, including turbo molecular pump.
    - b. Chamber designed to prevent metal ion contamination, ensuring compatibility with contamination-sensitive materials platforms (e.g. SOI wafers)
  2. Compatibility with four gas lines, including mass flow controllers.
  3. RF generators compatible with Low frequency (up to 100 W power) and High Frequency (up to 150 W power) processes.
  4. Chucks and tooling for 100- and 200-mm diameter wafers.
- D. Wafer cleaning station with enhanced functionalities. The station shall include top and back sides rinse processes, integrated with direct bonding and IR inspection capabilities for bare wafers.
1. Top-side and back-side rinse processes using deionized (DI) water to ensure effective particle and residue removal prior to bonding.
  2. Spin drying capability.
  3. Water dispenser line controlled by digital flow meter.
  4. Filter fan unit compliant with ISO Class 3 to ensure contamination control.
  5. Low contact chuck for direct bonding of bare wafers.
    - a. Prealigner paddle and bond chucks for 100- and 200-mm wafers, compatible with IR light, and wafers with flat and notch.
  6. Integrated IR inspection module for detection of unbonded areas or voids, with a void detection resolution of <1mm.
- E. Auxiliary equipment. All auxiliary equipment required for the operation of above system units, including vacuum pumps, cooling units and/or chemical cabinets where applicable, shall be included within the scope of supply.
- F. Bonding process development. Development and documentation of a bonding process recipe for at least one application, including definition process parameters and bonding validation.

### Software requirements

1. The system shall include the software required to manage all required functionalities described above, including process control, monitoring and data logging.
2. The software shall be installed on the system or on the PC supplied as part of the system, and shall be supplied with a permanent (non-expiring) license.

3. Any PC required for system operation or software execution shall be supplied by the vendor as part of the system.

#### **Technical documentation or manuals to be delivered**

A set of documentation shall be provided, covering the following topics:

- Comprehensive system user manual, including both hardware and software descriptions, routine servicing and troubleshooting.

#### **CLAUSE 4. Power distributions and safety**

The system shall include:

- Electrical Operation: 230V  $\pm 10\%$ , 50 Hz (per UNE-EN 61010-1, Spanish adoption of IEC 61010-1).
- CE-certification.
- The system will be fully protected against unexpected power cuts and, in that case, will be fully safe for the operators. A quick and easy turning on of the system has to be possible after a power cut.
- Safety interlocks and emergency stop system.

#### **CLAUSE 5. System Layout and Services Documentation**

The tenderer shall include in its technical proposal a complete "System Layout and Services Documentation" package, containing the following information:

- System layout, including overall footprint and height, weight, drawings and description of the different system components.
- Installation and start-up requirements, including required utilities, service connections, and any applicable environmental specification.

#### **CLAUSE 6. Transportation, Installation, Start-up and Acceptance**

- The contract includes the supply, transportation, installation and commissioning of the system at ICFO's facilities, as well as all components and consumables required for initial start-up, and any works or services necessary for its correct and full operation.
- The contractor shall deliver the system to ICFO's facilities. Accordingly, the contractor shall bear all costs and risks associated with transport, export and import licences, customs clearance and duties, import taxes, and any other charges arising until the system is made available at ICFO's premises. The contractor shall take out and maintain adequate transport insurance covering the full replacement value of the system until the moment of formal reception by ICFO.
- Any other customs or miscellaneous expenses, unexpected and not covered in the tender, which may arise until the equipment arrives at ICFO, must initially be borne by the Supplier and will be reimbursed

by ICFO upon submission of supporting documentation proving the actual incurrence of such expenses.

- The system shall be placed at the location designated by ICFO. The contractor shall cover all costs, organisation and coordination related to placement, including the provision of any specialised equipment or vehicles, and any necessary disassembly and reassembly of components required for building access or internal transportation, strictly following the route and access conditions specified by ICFO.

**Note:** The designated location has level, step-free access. Delivery shall be performed using a vehicle equipped with a loading ramp or liftgate, together with appropriate wheeled handling equipment. Any deviation from the agreed access route requires prior written authorisation from ICFO.

- The contractor shall be responsible for the removal and proper disposal of all packaging materials upon delivery and unpacking of the system, in compliance with Ley 7/2022, de 8 de abril, de residuos y suelo contaminado para una economía circular, and any applicable waste management regulations. Where the contractor determines that original packaging must be retained during the warranty period for potential return or re-shipment purposes, it shall notify ICFO in writing at the time of delivery. In such cases, the contractor shall store the packaging at its own cost and risk, unless ICFO agrees in writing to provide on-site storage space.

### **Process qualification**

A Factory Acceptance Test (FAT) shall be conducted at the contractor's premises prior to shipment (ICFO attendance at the FAT is not required). A Site Acceptance Test (SAT) shall be performed at ICFO's facilities following installation and commissioning of the system.

Final acceptance shall be conditional upon the successful completion of all of the following:

- a) *Technical parameter verification:* all system parameters shall be verified and shall meet the values specified in the Technical Specification. The following constitute minimum mandatory acceptance criteria, with their associated acceptance thresholds as defined therein: verification of pressure uniformity, vacuum level, heat up ramp rate, alignment precision.
- b) *Process demonstration:* the contractor shall demonstrate its standard bonding process, representative of typical system performance, using materials supplied by ICFO and following the approved SAT protocol.

Successful completion of the SAT shall trigger the formal act of reception (**Acta de Recepción**) pursuant to Article 210 LCSP. ICFO shall issue the corresponding reception certificate (Acta de Recepción) within one (1) month of SAT completion.

### **Protocol in the event of SAT failure and remediation deadlines.**

*Should the equipment fail any of the tests or verifications established in the SAT, the following protocol shall apply:*

1. *Formal notification of failure (Day 0): ICFO shall notify the contractor in writing and through a verifiable channel of the deficient results obtained, specifying in detail the parameters that did not meet the required values and attaching the corresponding measurement reports.*

2. *Corrective Action Plan (deadline: 5 working days from notification): the contractor shall submit to ICFO a written corrective Action Plan, identifying the root cause of the non-compliance, the proposed corrective measures, and an implementation schedule not exceeding 30 calendar days from the date of failure notification.*
3. *Re-execution of the SAT (deadline: maximum 30 calendar days from notification): once the corrective measures have been implemented, the contractor shall repeat the SAT in the presence of ICFO technical staff, within the aforementioned deadline. All costs associated with this repetition shall be borne entirely by the contractor.*

## CLAUSE 7. Warranty and Follow-on Support

- 1-year Full Warranty covering all parts and components of the system irrespective of the original manufacturer of each component. The warranty period shall begin to run from the date of the formal acceptance record (Acta de Recepción) issued by ICFO within a maximum period of one (1) month from the date of SAT completion. The warranty shall cover, at a minimum and at no additional cost to ICFO:
  - Replacement or repair of any part or component that fails or is found defective during normal operation, regardless of the component's manufacturer.
  - All costs of diagnosis, disassembly, repair or replacement, reassembly, and recommissioning, including consumables required for the repair.
  - Travel, accommodation and subsistence costs of all service engineers required for on-site intervention.
  - Shipping, insurance and handling costs for any component transported between ICFO and the contractor's facilities.
- System maintenance support available during, at least, 10 years, including access to technical assistance. The supplier shall provide feedback from a qualified technical specialist within 5 working days.
- Spare parts will be available during, at least, 10 years after system supply.
- An estimation of the cost of a warranty extension or available support contract options after warranty period will be included in the proposal.

## CLAUSE 8. Training

- The contractor shall provide a comprehensive training programme for ICFO personnel as an integral part of the contract, at no additional cost to ICFO.
- The training shall ensure proper and safe operation of the system and shall cover basic and advanced functionalities, including process development, programming and automation features.
- The training program shall also provide an overview of basic maintenance procedures, covering routine preventive tasks and essential troubleshooting guidelines.

## CLAUSE 9. Delivery and Installation Time

- The maximum execution period of the contract shall be **SIXTEEN (16) MONTHS**, counted from the day following the date of its formalisation.
- Within this period, the supplier must complete the manufacturing, transportation, delivery, installation, integration, commissioning of the system, and the execution of the Site Acceptance Tests (SAT). The delivery time shall therefore be understood as the full period required to complete all contractual obligations up to the successful acceptance of the equipment at ICFO facilities.
- Successful completion of the SAT shall trigger formal acceptance pursuant to Clause 6, with the warranty period under Clause 7 commencing from the date of the **Acta de Recepción**. Within thirty (30) days following said record, ICFO shall proceed with the final settlement of the contract and payment of any outstanding balance.

## CLAUSE 10. Tender budget

- The maximum tender budget (presupuesto base de licitación) for the supply, installation and commissioning of the system is **2.185.000,00 €** (VAT excluded).
- Payment terms:

The following payment schedule is proposed, divided into two (2) milestones to ensure clarity and transparent project follow-up:

**Milestone 1.** A payment of **25%** of the contract value shall be released upon delivery and approval of the following items, subsequent to a Kick-Off Meeting with ICFO personnel:

- a) A complete set of engineering documentation. This shall include system drawings, detailed technical descriptions, operation manuals, and all constructive documentation for the system and its components, including optional items.
- b) Definition and agreement of the bonding process recipe development activities, as specified in *Point F* of the Technical Specifications.
- c) Submission and approval of a detailed Site Acceptance Test (SAT) protocol, including material requested, test procedures and acceptance criteria.
- d) Presentation and agreement of training plan, following technical discussions with ICFO personnel.

Milestone 1 shall be completed within two (2) months counted from the day following the date of its formalisation.

**Milestone 2.** The remaining **75%** of the contract value shall be released upon:

- a) Completion of the system installation at the designated site, and
- b) Successful completion of the Site Acceptance Test (SAT), demonstrating full compliance with the technical requirements.
- c) Issue of the formal reception certificate (Acta de Recepción) by ICFO.



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Castelldefels, on the date of its digital signature

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